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ABSTRACT

This autoinstructional program, developed for high, medium and low level achievers, is directed toward a course in general science in middle schools. Mathematics of fractions and decimals is described as a prerequisite to the use of the packet. Two behavioral objectives are listed. Both involve the students' determining mass, first to the nearest tenth of a gram and a second, to the nearest one-tenth of a gram, using liquids and gases. The equipment needed is listed. A student guide, a vocabulary list and a copy of an evaluation exercise, with instructions and answers, are prepared for the teacher. (EB)

MASS - METRIC WEIGHT

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June 30, 1973

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TEACHER'S GUIDE

PACKET NUMBER	389.152 S1
SUBJECT	General Science
TITLE	Mass - Metric Weight
LEVEL	H M L
PREREQUISITES	Mathematics of fractions and decimals
BEHAVIORAL OBJECTIVES	1. Given an equal arm balance, 250ml graduate beaker, 10 ml graduate cylinder, 3/4" x 2 3/4" x 1 1/4" wooden cube, and 5 1/2" x 3 1/4" x 3/4" classroom sponge, the student after he balances the scale should determine the mass to the nearest tenth of a gram of 3 out of 5 objects. 2. Given an equal arm balance, 250 ml graduate beaker with 20 ml of water, 500 ml boiling flask with 30 ml of ethanol, 10 ml graduate with 1 ml of mercury, and deflated balloon, the student should balance the scale and determine the mass to the nearest .1 gram of 20 ml of water, of 30 ml of ethanol, of 1 ml of mercury,and of air.
EQUIPMENT	Cassette recorder Cassette tape Slide viewer, 4 slides Script platform balance Diagram of balance 250 ml beaker, graduate forceps Box with objects, "A-D" (A= 250 ml beaker, B- 10 ml graduate, C= wooden cube, 3/4" x 2 3/4" x 1 1/4", D= sponge, 5 1/2" x 3 1/4" x 3/4"), scratch paper, envelope "K" 100 ml beaker

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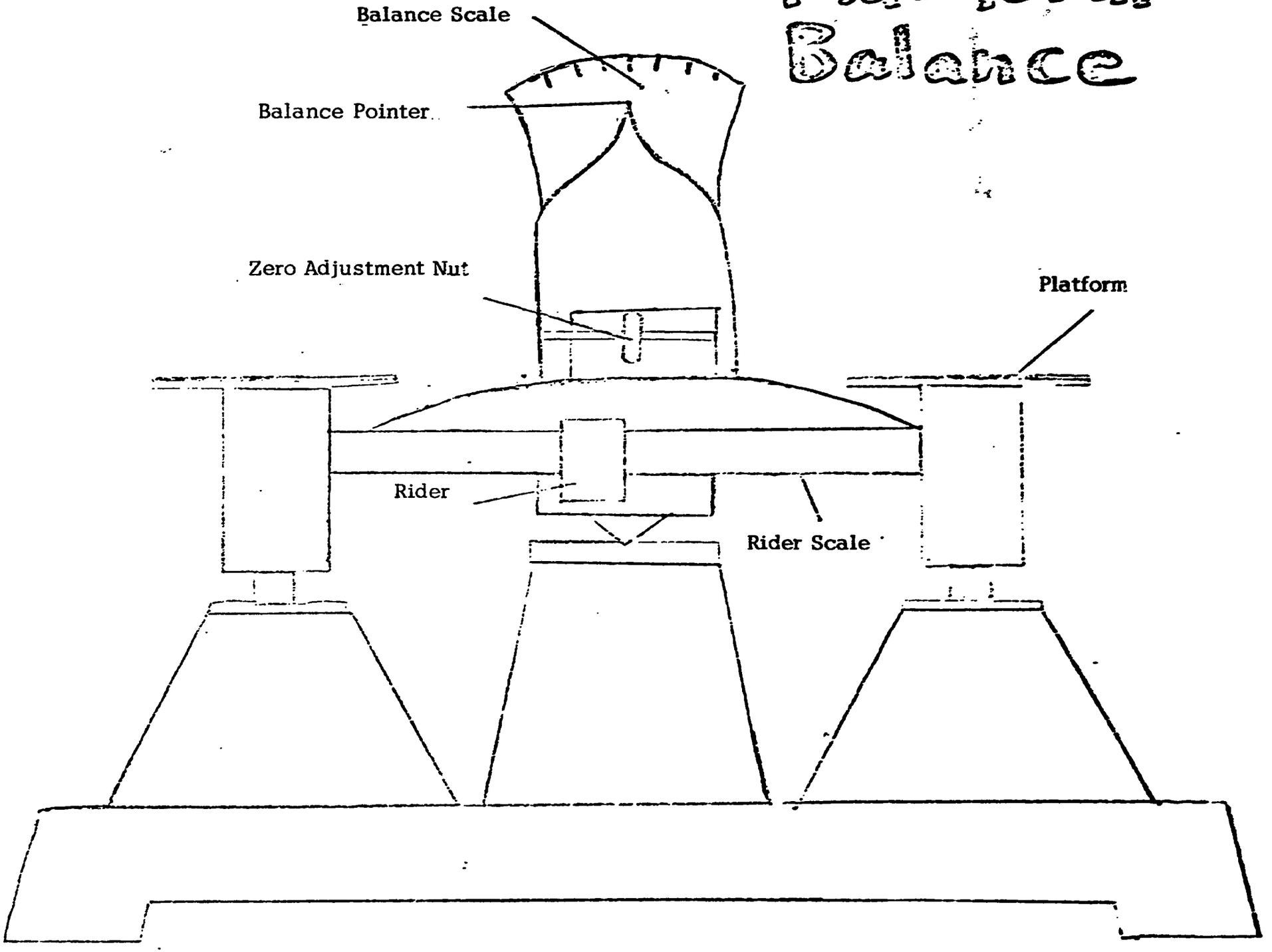
Platform Balance



STUDENT GUIDE

Metric system: metric mass, the gram

Use this guide to write any notes or comments you wish to keep from this experience.

1. Given an equal arm balance, 250 ml graduate beaker, 10 ml graduate cylinder. 3/4" x 2 3/4" x 1 1/4" wooden cube, and 5 1/2" x 3 1/4" x 3/4" classroom sponge, the student, after he balances the scale should determine the mass to the nearest tenth of a gram 3 of 5 objects.

2. Given an equal arm balance, 250 ml graduate beaker with 20 ml water, 500 ml boiling flask with 30 ml of ethanol, 10 ml graduate with 1 ml of mercury, and deflated balloon, the student should balance the scale and determine the mass to the nearest .1 gram of 20 ml of water, of 30 ml of ethanol, of 1 ml of mercury, and of air.

Take out a pencil; put on the headphones; turn on the tape player and follow the taped instructions.

SCRIPT

GENERAL SCIENCE
MASS - METRIC WEIGHT

This is the final tape on the metric system, metric mass. Remember, misunderstood instructions should be reheard. Music means stopping the tape, performing the operations, and proceeding with the tape.

The object in front of you is called a platform balance. This balance is seen in SLIDE 1 (pause). You may know the various parts of the balance. Other parts you may have forgotten. Look at SLIDE 2. This is a duplicate of the one in front of you with an exception - the standard mass in SLIDE 2 is not on the right platform, but on the rider. Familarize yourself with your platform balance. Use SLIDE 2 and the diagram of the balance for help. MUSIC.

Before you can find the mass of an object, check the balance to see where the position of the pointer is. If the pointer is not in the middle of the balance scale, then the scale is not balanced. Turn the zero adjustment nuts until the pointer is in the middle of the balance scale. This will take time and patience, since the platforms will swing to and fro. Music.

Now the balance is correct; let's determine the mass of something. Gently, place the 250 ml beaker on the left pan. If you were to measure chemicals, you would put a piece of paper on the balance

first and record its mass. To move the weights on the rider, use forceps. Never touch the weights with your fingers. Salts in your perspiration may corrode the weight. When the mass of the object is correct, the pointer will be in the same position as when the balance scale was empty of objects. Most scientists use a swinging end point. The pointer swings past the zero position the same number of marks as it does down. Read the bottom scale first. This is broken in 10 gram units and can accurately weigh 200 grams. The top rider measures whole grams and tenth of a gram, but no more than 10 grams. The mass of the beaker is found by adding the two scales, including the tenths of a gram. Now determine the mass of your beaker. Music. Your beaker will have a mass of 90.2 to 94.8 g. The reason for such range is that the quantity of glass in each 250 ml beaker varies even though the volume does not change.

Some balances have 3 riders, such as a triple beam balance. See SLIDE 3. (Pause) An object could have a mass of .1 gram or as much as 610 grams. Top rider goes from 0-100 g (broken into 10 g units), middle 0-500 g (broken into 100 g. units), and bottom grom 0-10 g. (broken into .1 g. units) Mass is calculated by adding the weights from the 3 riders. In this case, the object has a mass of 156.8 g.

You may wonder why we seem to stress "determine the mass of an object". Why not simply say, "Find the weight of the object"?

GENERAL SCIENCE
MASS - METRIC WEIGHT

Mass is the quantity of matter and does not change when its position or location on the earth is changed. Conversely, weight of an object does change according to position or location. One reason for this has to do with gravity. This means the earth's gravitional attraction is greatest at the Equator and least at the Poles even though mass would remain constant.

In the box at your carrel you will find objects labelled, "A" to "D". After you balance the scale, you are to find the mass to the nearest .1 g of each. Write your answers on scratch paper and check your answers with the ones in the envelope, marked "K". Music.

Previous tapes on the metric system have shown a relationship between one form of metric measure and another. We will show this next. Find the mass of a 1000 ml beaker. Use scratch paper. Music. Add to this beaker 490 ml of water. Use the water from the container marked "water". Remember to read the water level at the bottom of the meniscus. (Pause) Now determine the mass of the beaker and water. Music. What is the mass of the water? (Pause) Look at SLIDE 4. (Pause) The top line has the mass of the beaker, which is 301 g. Next is the beaker and 490 ml of water with a mass of 793.7 g. To determine the mass of 490 ml of water, subtract the mass of beaker from the mass of beaker and water or 301 from 793.7, which is 492.7, the mass of water. How would you answer the last line? (Pause) 1 ml of water has a

mass close to 1 g. This was found by dividing the number value of volume measure into the number value of mass measure, or 490 into 793.7. Only with water is the statement, 1 ml has a mass of 1 g. You will see how this is so by performing the next operation.

Take the paper labelled, "O". The following exercise will be performed in the laboratory. You will determine the mass of three different liquids, water, ethanol, and mercury plus a gas, air. Remember to keep your skin from touching the mercury. It can harm you. Use the procedure explained earlier to determine the mass of something in a container. Take your paper when finished to your instructor. He will check your answers.

Remember to rewind the tape. Replace all containers and papers in the proper places in both the carrel and laboratory. Music.

VOCABULARY LIST

zero adjustment nuts	part of platform balance that helps to balance the platform
rider scale	horizontal bar on which weights or riders move
rider	a moveable weight
triple beam balance	scale with 3 riders (horizontal bars)
platform balance	equal arm scale with 1 or 2 rider scales graduated - marked in equal units
mass	quantity of matter
weight	matter that changes with position and/or location on earth's surface or in universe
1 cc	cubic centimeter, basically a volume measure
ethanol	ethyl alcohol

INSTRUCTIONS TO TEACHER ABOUT PAPER "O"

Please prepare ahead and perform in laboratory.

1. copies of paper "O"
2. Platform balance
3. Paper towels and sponge for clean up
4. 250 ml beaker
5. At least 20 ml of water
6. 500 ml boiling flask
7. At least 30 ml of ethanol
8. 10 ml graduate
9. At least 1 ml mercury
10. Balloon, 1" x 2"

"0"

Name_____

Directions: Perform in laboratory. Using a balance, determine the mass of water, ethanol, mercury, and air. Caution: Keep skin from touching mercury. Clean work area. Check answers with instructor.

I. Mass of water

a. mass of 250 ml beaker empty_____grams

b. mass of 250 ml beaker and 20 ml of water _____grams

c. mass of 20 ml of water _____grams

d. Yes or No: Does 1 ml of water equal 1 g.? _____

II. Mass of ethanol

a. mass of 500 ml boiling flask empty _____grams

b. mass of 500 ml boiling flask and 30 ml of ethanol _____grams

c. mass of 30 ml of ethanol _____grams

d. Yes or No: Does 1 ml of ethanol equal 1 g.? _____

III Mass of mercury

a. mass of 10 ml graduate empty _____grams

b. Mass of 10 ml graduate and 1 ml mercury _____grams

c. mass of 1 ml of mercury _____ grams

d. Yes or No: Does 1 ml of mercury equal 1 g.? _____

IV. Mass of air

a. mass of deflated balloon _____ gram

b. mass of balloon and air _____ gram

c. mass of air _____ gram

ANSWERS FOR PAPER "O"

I. a. 92.7 g.

b. 112 g.

c. 19.3 g.

d. yes

II a. 162.6 g.

b. 187.7 g.

c. 25.1 g.

d. no

III a. 37.2 g.

b. 50.7 g.

c. 13.5 g.

d. no

IV a. 1.1 g.

b. 1.4 g.

c. .3 g.